

PATENT APPLICATION
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Docket No: Q73500

Masahiro AMEMIYA, et al.

Appln. No.: 10/538,929

Group Art Unit: Unknown

Confirmation No.: 5996

Examiner: Unknown

Filed: June 13, 2005

For: CLEANING AGENT COMPOSITION, CLEANING AND PRODUCTION METHODS
FOR SEMICONDUCTOR WAFER, AND SEMICONDUCTOR WAFER

STATEMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, Masato Kaneda, hereby declare and state as follows:

I am employed by Showa Denko K.K., and am the person at Showa Denko K.K. responsible for contacting Masahiro Amemiya, one of the co-inventors of the invention claimed in the above-identified application, to have him execute a Declaration and Power of Attorney and an Assignment for this application.

On May 13, 2005, I called for Mr. Amemiya and left a message with his family explaining about this case and asking for Mr. Amemiya's signature on the Declaration and Power of Attorney and the Assignment documents.

On May 15, 2005, I received a facsimile from Mr. Amemiya, in which he indicated the address to which the documents were to be sent.

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On May 16, 2005, I sent the Declaration and Assignment to Mr. Amemiya by express mail.

On May 30 or 31, 2005, I left a message with Mr. Amemiya's family indicating that Showa Denko K.K. was waiting for the executed documents, no answer was received from Mr. Amemiya thereafter.

On November 15, 2005, to again try to obtain Mr. Amemiya's signature on the Declaration and Assignment, I prepared a letter to Mr. Amemiya enclosing the specification and claims (WO 2004/053045 A1), the Declaration, and the Assignment, and requesting that he sign and return the Declaration and Assignment.

In this regard, a copy of my letter of November 15, 2005 to Mr. Amemiya is attached hereto as Document 1. A summary of the letter is as follows:

"The following documents are enclosed.

1. Specification and claims (WO 2004/053045 A1)
2. Declaration
3. Assignment

Please sign the Declaration and the Assignment and return them to us.

If you do not sign them for some reason, could you please advise us accordingly?"

Further in this regard, a copy of all the application papers attached to my letter of November 15, 2005 to Mr. Amemiya is attached hereto as Document 2.

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Also, a copy of the envelope used to send my November 15, 2005 letter with the application papers to Mr. Amemiya is attached hereto as Document 3. It indicates that the documents enclosed are 1. Specification/claims, 2. Declaration, 3. Assignment, and 4. Letter.

My November 15, 2005 letter with a copy of all the application papers (specification, claims, Declaration and Assignment) was sent to Mr. Amemiya by registered mail on November 16, 2005.

In this regard, Receipt of Registered Mail / No. 179-26-46556-1 is attached hereto as Document 4. It indicates that the sender is Showa Denko and the addressee is Masahiro Amemiya, and that the Post Office received the registered mail on November 16, 2005.

Mr. Amemiya received the registered mail on November 18, 2005.

In this regard, Registered Mail Search Result for Registered Mail No. 17926465561 is attached hereto as Document 5. It indicates that the mail was delivered to the addressee on November 18, 2005.

However, despite all the above, Showa Denko has not yet received the executed Declaration and Assignment from Mr. Amemiya. I could not talk to Mr. Amemiya directly because he refused direct contact to himself by either telephone or e-mail, so I do not know the exact reason why Mr. Amemiya has not executed the documents.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are

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punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issuing therefrom.

Date: June 14, 2006

By: 
Masato Kaneda

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2005 年 11 月 15 日

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件名： 特許関連書類ご送付の件

拝啓

大変お世話になっております。

昭和電工株式会社 情報電子化学品部 ソルファイン開発グループ 金田です。

ますます御健勝のこととお喜び申し上げます。

さて、雨宮様が、弊社在社時に出願頂いた特許について、米国出願に関連した下記の書類を同封させて頂きました。

内容のご確認を頂いたうえ、同封の宣誓書及び譲渡書の計 2 箇所にご署名頂き、同封させて頂きました封筒にて折り返し昭和電工金田宛、ご返送頂きますようお願い申し上げます。

記

1. 特許明細書 (WO 2004/053045 A1)
2. 出願宣言書(Declaration) (3 枚)
3. 譲渡書(Assignment) (1 枚)

本件、5 月にご送付させて頂いたものの一部を再度お送りさせていただいております。

もし、雨宮様の事情によりご署名いただけないようでしたら、その旨金田までご連絡いただけると幸いです。

お手数おかけいたしますが、宜しくお願い致します。

不明な点ございましたら、金田までご一報下さい。

金田 昌人

敬具

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111, Aza Nagayachi, Oaza Higashinagahara, Kawahigashi-machi, Kawanuma-gun, Fukushima 969-3431 (JP).

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(72) Inventors; and

(75) Inventors/Applicants (*for US only*): AMEMIYA, Masahiro [JP/JP]; c/o TOKUYAMA PLANT, ORGANIC CHEMICAL DIVISION, SHOWA DENKO K.K., 4980, Kaisei-cho, Shunan-shi, Yamaguchi 746-0006 (JP). TANAKA, Yoshio [JP/JP]; c/o SHOWA DENKO K.K.,

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: CLEANING AGENT COMPOSITION, CLEANING AND PRODUCTION METHODS FOR SEMICONDUCTOR WAFER, AND SEMICONDUCTOR WAFER

(57) Abstract: A cleaning agent composition comprising a nonionic surfactant represented by the following formula (I): $R_1O(EO)_x(PO)_yH$ (I) (wherein R_1 represents a linear or branched alkyl group having from 6 to 20 carbon atoms or a linear or branched alkenyl group having from 6 to 20 carbon atoms, EO represents an oxyethylene group, PO represents an oxypropylene group, EO and PO each is bonded by random addition or block addition, x number of EOs and y number of POs are arranged in an arbitrary order, x and y each independently represents an integer of 1 to 20, and $x/(x+y)$ is 0.5 or more) and a quaternary ammonium hydroxide is provided. Also, Cleaning and production methods for semiconductor wafer using the cleaning agent composition, and semiconductor wafer produced by the production method are provided.

WO 2004/053045 A1

DESCRIPTION

Cleaning Agent Composition, Cleaning and Production
Methods for Semiconductor Wafer, and Semiconductor
Wafer

5

CROSS REFERENCES OF RELATED APPLICATION

This application is an application filed under 35
U.S.C. §111(a) claiming benefit pursuant to 35 U.S.C.
§119(e)(1) of the filing date of Provision Application
10 60/434,663 filed on December 20, 2002 pursuant to 35 U.S.C.
§111(b).

TECHNICAL FIELD

The present invention relates to a cleaning agent
15 composition suitable for the cleaning of a semiconductor
wafer such as silicon, gallium-arsenic, gallium-phosphorus
and indium-phosphorus, the cleaning of electronics-related
various glass substrates such as liquid crystal display
glass substrate, solar cell glass substrate and crystal
20 substrate, and the cleaning of a glass or ceramic-made
precision work member requiring high cleanliness, such as
lens for optical glasses, prism, optical fiber, quartz
oscillator and polishing plate for semiconductor wafers.
The present invention also relates to methods for cleaning

or producing a semiconductor wafer by using the composition and a semiconductor wafer produced by the production method.

5 BACKGROUND ART

Semiconductor devices such as transistor, diode, IC, LSI and rectifying element are produced by applying steps such as vapor growth, formation of oxide film, diffusion of impurities and vapor deposition of electrode metal film, to a silicon wafer or a compound semiconductor wafer such as gallium-arsenic, gallium-phosphorus and indium-phosphorus.

The electric characteristics of a semiconductor device are greatly affected by impurities and therefore, the semiconductor wafer surface is thoroughly cleaned to remove the contamination with impurities before applying respective steps described above. As industrial means therefor, a large number of methods using a treating solution mainly comprising an organic alkali or using a treating solution obtained by adding a complexing agent, a surfactant, an aqueous hydrogen peroxide and the like to an organic alkali have been proposed (see, for example, JP-A-50-147287 (the term "JP-A" as used herein means an "unexamined published Japanese patent application"),

Japanese Patent No. 2579401 and JP-A-2001-214199.

For example, JP-A-50-147287 discloses that the sole use of an aqueous solution of, for example, trimethylhydroxyethylammonium hydroxide (choline) or tetramethylammonium hydroxide (hereinafter sometimes referred to as "TMAH") out of tetraalkylammonium hydroxides is effective in the degreasing, removal of contamination with inorganic substances and removal of ultra-thin oxide layer.

However, (1) due to poor wettability to the surface to be treated, the cleaning power is not sufficiently high, and (2) due to etching dependency on the orientation of silicon crystal such that the (100) plane is readily etched and the (111) plane is resistant against etching activity, in the case of a (100) mirror face wafer, this plane is roughened by etching. Thus, problems still remain.

In order to solve these problems, a system where a complexing agent and a hydrogen peroxide are added to an aqueous tetraalkylammonium hydroxide solution is proposed.

However, the cleaning power is not satisfied depending on the purpose or when hydrogen peroxide and an aqueous alkali solution such as tetraalkylammonium hydroxide are used in combination, the hydrogen peroxide decomposes in a short time and therefore, various

cumbersome operations are necessary for keeping constant the concentration.

Japanese Patent No. 2579401 describes an aqueous organic alkali solution comprising a tetraalkylammonium hydroxide, an alkanolamine and a nonionic surfactant, and discloses that by using the surfactant, the cleaning power is enhanced and the etching of the silicon crystal (100) plane can be suppressed.

However, the effect of preventing the etching is not sufficiently high and the performance of removing particles is also not satisfied.

JP-A-2001-214199 describes a cleaning solution comprising a hydroxide, water, a water-soluble organic compound and a specific nonionic surfactant.

However, this cleaning solution is not sufficiently high in the activity of removing contamination with oils and fats, though the activity of preventing etching on the silicon crystal (100) plane is enhanced.

Furthermore, due to low solubility of the specific nonionic surfactant in an aqueous alkali solution, a water-soluble organic compound such as isopropyl alcohol must be added so as to elevate the solubility.

With recent progress of highly integrated semi-conductors, the level of performance required of the

cleaning solution is more and more elevating. Under these circumstances, a new cleaning solution improved in the performance of removing surface contamination of a material to be cleaned and in the effect of preventing etching is being demanded.

DISCLOSURE OF INVENTION

An object of the present invention is to provide a cleaning agent composition having an excellent cleaning power against surface contamination of, for example, a semiconductor wafer, various glass substrates and a glass- or ceramic-made precision work member required to have high cleanliness, exhibiting excellent performance in both the degreasing and the removal of particles on the wafer surface at the cleaning of a semiconductor wafer, and enabling satisfactory control in the etching of a wafer.

Another object of the present invention is to provide a method for cleaning a semiconductor wafer, where an excellent cleaning power is exhibited against the surface contamination of a semiconductor wafer and the etching of the wafer is satisfactorily controlled.

Still another object of the present invention is to provide a production method for obtaining a semiconductor wafer extremely reduced in particles attached to the

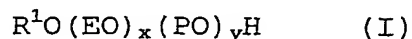
semiconductor wafer surface and extremely reduced in the surface roughness..

Yet still another object of the present invention is to provide a semiconductor wafer extremely reduced in
5 particles attached to the semiconductor wafer surface and extremely reduced in the surface roughness.

As a result of extensive investigations to solve those problems, the present inventors have found that the above-described objects can be attained by using a
10 cleaning agent composition comprising a specific nonionic surfactant and a quaternary ammonium hydroxide or further comprising an alkanolamine. The present invention has been accomplished based on this finding.

That is, the present invention is summarized as
15 follows.

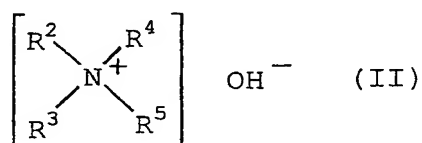
[1] A cleaning agent composition comprising a nonionic surfactant represented by the following formula (I):



(wherein R^1 represents a linear or branched alkyl group
20 having from 6 to 20 carbon atoms or a linear or branched alkenyl group having from 6 to 20 carbon atoms, EO represents an oxyethylene group, PO represents an oxypropylene group, EO and PO each is bonded by random addition or block addition, x number of EOs and y number

of POs are arranged in an arbitrary order, x and y each independently represents an integer of 1 to 20, and $x/(x+y)$ is 0.5 or more) and a quaternary ammonium hydroxide.

- 5 [2] The cleaning agent composition as described in [1] above, wherein the quaternary ammonium hydroxide is a compound represented by the following formula (II):

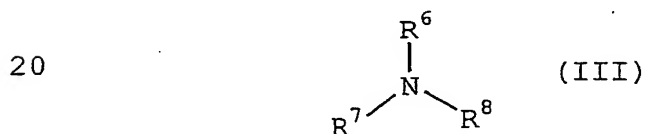


(wherein R^2 , R^3 , R^4 and R^5 each independently represents an
10 alkyl group having from 1 to 6 carbon atoms or a hydroxy-alkyl group having from 1 to 6 carbon atoms).

- [3] The cleaning agent composition as described in [2] above, wherein the quaternary ammonium hydroxide is tetramethylammonium hydroxide.

- 15 [4] The cleaning agent composition as described in [1] above, which further comprises an alkanolamine.

- [5] The cleaning agent composition as described in [4] above, wherein the alkanolamine is a compound represented by the following formula (III):



(wherein R^6 represents a hydroxyalkyl group having from 1

to 4 carbon atoms; and R^7 and R^8 each independently represents a hydrogen atom, an alkyl group having from 1 to 4 carbon atoms, a hydroxyalkyl group having from 1 to 4 carbon atoms or an aminoalkyl group having from 1 to 4 carbon atoms, or R^7 and R^8 combine to form an alkylene group having from 3 to 6 carbon atoms, and the alkylene group may have an oxygen or nitrogen atom inserted between carbon atoms constituting the main chain).

[6] The cleaning agent composition as described in [5] above, wherein the alkanolamine is any one compound selected from the group consisting of monoethanolamine, diethanolamine and triethanolamine.

[7] The cleaning agent composition as described in [4] above, wherein the alkanolamine is contained in an amount of 0.001 to 50 mass% based on the entire amount of the cleaning agent composition.

[8] The cleaning agent composition as described in [1] above, wherein the nonionic surfactant is contained in an amount of 0.0001 to 10 mass% based on the entire amount of the cleaning agent composition.

[9] The cleaning agent composition as described in [8] above, wherein the quaternary ammonium hydroxide is contained in an amount of 0.001 to 30 mass% based on the entire amount of the cleaning agent composition.

[10] A method for cleaning a semiconductor wafer, comprising the steps of:

(i) cleaning the wafer using the cleaning agent composition described in any one of [1] to [9] above; and

5 (ii) cleaning the wafer using a composition containing ammonia and hydrogen peroxide.

[11] The method for cleaning a semiconductor wafer as described in [10] above, wherein the degreasing and removal of particles on the semiconductor wafer surface
10 are performed in the step (i).

[12] The method for cleaning a semiconductor wafer as described in [11] above, wherein the removal of particles on the semiconductor wafer surface are performed in the step (ii).

15 [13] A method for producing a semiconductor wafer, comprising the steps of:

lapping the wafer surface;

specularly polishing the wafer surface;

cleaning the wafer using the cleaning agent
20 composition described in any one of [1] to [9] above; and

cleaning the wafer using a composition containing ammonia and hydrogen peroxide.

[14] A semiconductor wafer produced by the production method described in [13] above.

[15] The semiconductor wafer as described in [14] above wherein the number of particles attached to the wafer surface and having a particle size of 0.2 μm or more is 130 or less per 100 cm^2 of the wafer surface.

5 [16] The semiconductor wafer as described in [14] above, wherein the semiconductor wafer is a silicon wafer, a gallium-arsenic wafer, a gallium-phosphorus wafer or an indium-phosphorus wafer.

[17] The semiconductor wafer as described in [16] above,
10 wherein the semiconductor wafer is a silicon wafer and the surface roughness (Ra) is 0.2 nm or less.

[18] The semiconductor wafer as described in [16] above, wherein the semiconductor wafer is gallium-arsenic wafer and the surface roughness (Ra) is 0.4 nm or less.

15 The cleaning agent composition of the present invention comprises a specific nonionic surfactant and a quaternary ammonium hydroxide, so that this composition has excellent cleaning power against surface contamination of a semiconductor wafer such as silicon, gallium-arsenic,
20 gallium-phosphorus and indium-phosphorus, electronics-related various glass substrates such as liquid crystal display glass substrate, solar cell glass substrate and crystal substrate, and a glass or ceramic-made precision work member requiring high cleanliness, such as lens for

optical glasses, prism, optical fiber, quartz oscillator and polishing plate for semiconductor wafers.

Particularly, in the cleaning of a semiconductor wafer, the cleaning agent composition of the present invention exhibits excellent performance in both the degreasing and removal of particles on the wafer surface and can satisfactorily control the etching of the wafer cleaned.

Furthermore, by further containing an alkanolamine, the composition can be more enhanced in the cleaning property and the life.

According to the method for cleaning a semiconductor wafer of the present invention, excellent performance can be exhibited in both the degreasing and removal of particles on the wafer surface and at the same time, the etching of the wafer cleaned can be satisfactorily controlled.

According to the method for producing a semiconductor wafer of the present invention, a semiconductor wafer extremely reduced in the particles attached to the wafer surface and remarkably reduced in the surface roughness can be obtained.

The semiconductor wafer of the present invention is extremely reduced in the particles attached to the wafer

surface and remarkably reduced in the surface roughness.

BEST MODE FOR CARRYING OUT THE INVENTION

<Cleaning Agent Composition>

5 The essential components of the cleaning agent composition of the present invention are a nonionic surfactant of formula (I) and a quaternary ammonium hydroxide. The cleaning agent composition comprising these essential components can exhibit excellent cleaning
10 power against the surface contamination of a semiconductor wafer and at the same time, can satisfactorily control the etching of the wafer.

 In the nonionic surfactant of formula (I), R^1 is a linear or branched alkyl group having from 6 to 20 carbon
15 atoms or a linear or branched alkenyl group having from 6 to 20 carbon atoms.

 Specific examples of the alkyl group include a hexyl group, an isohexyl group, a methylpentyl group, a dimethylbutyl group, an ethylbutyl group, a heptyl group,
20 a methylhexyl group, a propylbutyl group, a dimethylpentyl group, an octyl group, a nonyl group, a decyl group, a methylnonyl group, an ethyloctyl group, a dimethyloctyl group, an undecyl group, a dodecyl group, a tridecyl group, a tetradecyl group, a pentadecyl group, a heptadecyl and a

nonadecyl group.

Specific examples of the alkenyl group include a hexenyl group, a methylpentenyl group, a decenyl group, an undecenyl group, a dodecenyl group, a tridecenyl group, a
5 pentadecenyl group, a pentadecatrienyl group, a heptadecenyl group, a heptadecadienyl group and a nonadecenyl group.

The oxyethylene group (EO) is represented by $-\text{CH}_2-\text{CH}_2-\text{O}-$ and the oxypropylene group (PO) is represented
10 by $-\text{CH}(\text{CH}_3)-\text{CH}_2-\text{O}-$ or $-\text{CH}_2-\text{CH}(\text{CH}_3)-\text{O}-$. EO and PO each is bonded by random addition or block addition and x number of EOs and y number of POs are arranged in an arbitrary order.

x and y each independently represents an integer of
15 1 to 20. Here, the value of $x/(x+y)$ must be 0.5 or more and when this value is 0.5 or more, a sufficiently high solubility in an aqueous alkali solution can be obtained. This value is preferably from 0.5 to less than 1.

Specific examples of the nonionic surfactant of
20 formula (I) include a polyoxyethylene polyoxypropylene decanyl ether, a polyoxyethylene polyoxypropylene undecanyl ether, a polyoxyethylene polyoxypropylene dodecanyl ether and a polyoxyethylene polyoxypropylene tetradecanyl ether (those where x and y satisfy the above-

described conditions). Among these surfactants, those where $x=2$ to 15, $y=2$ to 15 and R is a linear or branched alkyl group having from 8 to 18 carbon atoms or a linear or branched alkenyl group having from 8 to 18 carbon atoms
5 are preferred.

The nonionic surfactant of formula (I) is contained in an amount of 0.0001 to 10 mass%, preferably from 0.0001 to 1 mass%, more preferably from 0.0001 to 0.5 mass%, based on the entire amount of the cleaning agent
10 composition of the present invention. If the nonionic surfactant content exceeds 10 mass%, problems such as bubbling or rinsing are disadvantageously caused, whereas if the content is less than 0.0001 mass%, a sufficiently high effect cannot be obtained in the cleaning and
15 prevention of etching.

In the present invention, the quaternary ammonium hydroxide used together with the nonionic surfactant of formula (I) is preferably a compound represented by formula (II).

20 In the quaternary ammonium hydroxide of formula (II), R^2 , R^3 , R^4 and R^5 may be the same or different and each independently represents an alkyl group having from 1 to 6 carbon atoms or a hydroxyalkyl group having from 1 to 6 carbon atoms.

Specific examples of the quaternary ammonium hydroxide of formula (II) include tetramethylammonium hydroxide (TMAH), trimethylhydroxyethylammonium hydroxide (choline), methyltrihydroxyethylammonium hydroxide, 5 dimethyldihydroxyethylammonium hydroxide, tetraethylammonium hydroxide and trimethylethylammonium hydroxide. Among these, tetramethylammonium hydroxide and trimethylhydroxyethylammonium hydroxide are preferred. These quaternary ammonium hydroxides may be used 10 individually, or two or more thereof may be used in combination at an arbitrary ratio.

The quaternary ammonium hydroxide is contained in an amount of 0.001 to 30 mass%, preferably from 0.05 to 20 mass%, based on the entire amount of the cleaning agent 15 composition of the present invention. If the concentration of the quaternary ammonium hydroxide exceeds 30 mass%, the wafer is excessively etched and the etching cannot be controlled, giving rise to problems such as roughening of the wafer surface, whereas if the 20 concentration is less than 0.001 mass%, a sufficiently high cleaning property cannot be maintained.

In addition to the nonionic surfactant of formula (I) and the quaternary ammonium hydroxide, the cleaning agent composition of the present invention may further

contain an alkanolamine. By containing an alkanolamine, the composition can be used as a cleaning agent enhanced in the cleaning property and in the life. The alkanolamine is preferably a compound represented by
5 formula (III).

In the alkanolamine of formula (III), R⁶ represents a hydroxyalkyl group having from 1 to 4 carbon atoms.

R⁷ and R⁸ may be the same or different and each independently represents a hydrogen atom, an alkyl group
10 having from 1 to 4 carbon atoms, a hydroxyalkyl group having from 1 to 4 carbon atoms or an aminoalkyl group having from 1 to 4 carbon atoms. R⁷ and R⁸ may also combine to form an alkylene group having from 3 to 6 carbon atoms. The alkylene group may have an oxygen or
15 nitrogen atom inserted between carbon atoms constituting the main chain, for example, between carbon atoms of a methylene group as in -CH₂-O-CH₂- or -CH₂-N-CH₂-.

Specific examples of the alkanolamine of formula (III) include monoethanolamine, diethanolamine and
20 triethanolamine. One of these alkanolamines may be used alone or two or more thereof may be used in combination at an arbitrary ratio.

The alkanolamine is contained in an amount of 0.001 to 50 mass%, preferably from 0.01 to 30 mass%, more

preferably from 0.1 to 20 mass%, based on the entire amount of the cleaning agent composition of the present invention. If the concentration of alkanolamine exceeds 50 mass%, the cleaning performance disadvantageously decreases and this is also not preferred in view of profitability, whereas if the concentration is less than 0.001 mass%, the cleaning effect by the addition of an alkanolamine is not sufficiently high.

In the cleaning agent composition of the present invention, a surfactant other than the compound of formula (I) may be added so as to enhance the cleaning property. Examples of such a surfactant include a carboxylic acid represented by the following formula (IV):



(wherein R^9 represents a linear or branched alkyl group having from 2 to 20 carbon atoms, where hydrogen atoms may be partially or entirely replaced by a fluorine atom, or a linear or branched alkenyl group having from 2 to 20 carbon atoms, where hydrogen atoms may be partially or entirely replaced by a fluorine atom, and M represents a hydrogen atom, an alkali metal atom, an ammonium group, an alkylammonium group or an alkanolammonium group) or a salt thereof;

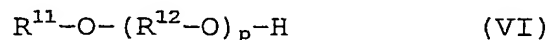
a sulfonic acid represented by the following formula

(V):



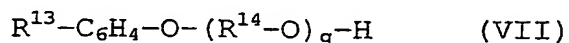
(wherein R^{10} represents a linear or branched alkyl group having from 2 to 20 carbon atoms, where hydrogen atoms may be partially or entirely replaced by a fluorine atom, or a linear or branched alkenyl group having from 2 to 20 carbon atoms, where hydrogen atoms may be partially or entirely replaced by a fluorine atom, and M represents a hydrogen atom, an alkali metal atom, an ammonium group, an alkylammonium group or an alkanolammonium group) or a salt thereof;

a polyoxyalkylene alkyl ether type represented by the following formula (VI):



(wherein R^{11} represents a linear or branched alkyl group having from 6 to 20 carbon atoms, R^{12} represents an alkylene group having from 2 to 4 carbon atoms, and p represents an integer of 3 to 20);

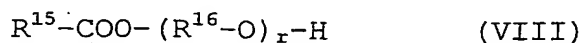
a polyoxyalkylene aryl ether type represented by the following formula (VII):



(wherein R^{13} represents a linear or branched alkyl group having from 6 to 20 carbon atoms, R^{14} represents an alkylene group having from 2 to 4 carbon atoms, and q

represents an integer of 3 to 20); and

a polyoxyalkylene alkyl ester type represented by the following formula (VIII):



- 5 (wherein R^{15} represents a linear or branched alkyl group having from 9 to 16 carbon atoms, R^{16} represents an alkylene group having from 2 to 4 carbon atoms, and r represents an integer of 6 to 16).

In some cases, use of a fluorine-containing anionic
 10 surfactant is particularly effective. Specific examples of the fluorine-containing anionic surfactant include perfluoroheptanoic acid ($C_6F_{13}COOH$), perfluorocaprylic acid ($C_7F_{15}COOH$), perfluorononanoic acid ($C_8F_{17}COOH$), 5,5,6,6,7,7,8,8,9,9,9-undecafluorononanoic acid ($C_5F_{11}(CH_2)_3COOH$),
 15 perfluorocapric acid ($C_9F_{19}COOH$), perfluorododecanoic acid ($C_{11}F_{23}COOH$), 6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-pentadecafluoro-4-dodecenoic acid ($CF_3(CF_2)_6CH=CH(CH_2)_2COOH$), perfluorotetradecanoic acid ($C_{13}F_{27}COOH$), 12-trifluoromethyl-
 20 12,13,13,14,14,15,15,16,16,16-decafluorohexadecanoic acid ($CF_3(CF_2)_3CF(CF_3)(CH_2)_{10}COOH$), perfluorooctanesulfonic acid ($C_8F_{17}SO_3H$), and ammonium salts and tetramethylammonium salts thereof.

These surfactants other than the compound

represented by formula (I) may be used individually or two or more thereof may be used in combination at an arbitrary ratio.

This surfactant is contained in an amount of 0.0001 to 5 mass%, preferably from 0.0001 to 1 mass%, more preferably from 0.0001 to 0.5 mass%, based on the entire amount of the cleaning agent composition of the present invention. If the content exceeds 5 mass%, problems such as bubbling or rinsing may disadvantageously arise, whereas if the content is less than 0.0001 mass%, the activity of enhancing the cleaning power cannot be satisfactorily brought out.

In the cleaning agent composition of the present invention, hydrogen peroxide can be added. In the case of cleaning a silicon wafer, the etching of wafer can be prevented by the addition of only a surfactant to the aqueous alkali solution. However, this effect is greatly affected by the kind of surfactant, the alkali concentration, the temperature and the like and a sufficiently high effect is not always obtained in all possible conditions. By using hydrogen peroxide, the etching on the wafer surface can be appropriately controlled even at high temperatures (for example, from 60 to 80°C) and the cleaning agent composition of the present

invention can be broadened in the range of use.

In the case of adding hydrogen peroxide, the hydrogen peroxide may be added in the range from 0.01 to 20 mass%, preferably from 0.05 to 10 mass%, based on the entire amount of the cleaning agent composition. If the hydrogen peroxide concentration exceeds 20 mass%, the amount of hydrogen peroxide decomposed increases and this is not profitable, though the cleaning power itself is not particularly affected. On the other hand, if the concentration is less than 0.01 mass%, a sufficiently high effect of preventing etching cannot be obtained.

In the cleaning agent composition of the present invention, a complexing agent may be further added so as to enhance the cleaning power for metal ion. Specific examples of the complexing agent include ethylenediamine-tetraacetic acid, diethylenetriaminepentaacetic acid, citric acid, gluconic acid, oxalic acid, tartaric acid and aleic acid. In the case of adding a complexing agent, the complexing agent can be added in an arbitrary amount within the range where the etching of wafer does not proceed.

The cleaning agent composition of the present invention exhibits an excellent cleaning effect at ordinary temperature and this composition can also be used

for the cleaning under appropriate heating or for the cleaning using ultrasonic wave.

The cleaning agent composition of the present invention exhibits high contamination-removing performance and enables effective surface cleaning in a relatively short time not only when used for the cleaning of a semiconductor wafer but also when used for the surface cleaning of electronics-related various glass substrates such as liquid crystal display glass substrate, solar cell glass substrate and crystal substrate, or for the surface cleaning of a glass or ceramic-made precision work member requiring high cleanliness, such as lens for optical glasses, prism, optical fiber, quartz oscillator and polishing plate for semiconductor wafers.

15 <Method for Cleaning Semiconductor Wafer>

The method for cleaning a semiconductor wafer of the present invention comprises:

(i) cleaning the wafer using the above-described cleaning agent composition; and

20 (ii) cleaning the wafer using a cleaning agent containing ammonia and hydrogen peroxide.

The cleaning step (i) is a step provided mainly for performing the degreasing and removal of particles on the semiconductor wafer surface.

The cleaning step (ii) is a step provided mainly for performing the removal of particles on the semiconductor wafer surface.

Examples of the semiconductor wafer which can be
5 cleaned by using the cleaning method of the present invention include one-element semiconductor wafers such as silicon and germanium, and compound semiconductor wafers such as gallium-phosphorus, gallium-arsenic and indium-phosphorus.

10 Representative examples of the step for performing the degreasing and removal of particles on the semiconductor wafer surface include wax cleaning after specular polishing of a wafer. The specular polishing of a semiconductor wafer is performed by bonding/fixing the
15 wafer to a plate (jig) with a wax. Therefore, when the wafer is stripped off from the plate after the completion of polishing, a large amount of wax used as an adhesive remains adhering to the wafer. The above-described cleaning agent composition of the present invention is
20 particularly effective for the cleaning to remove the wax and particles adhering to the wafer and this composition is used in the cleaning step (i).

The cleaning agent composition of the present invention provides both a wax-removing effect and a

particle-removing effect even when used by itself, but when used in combination with other cleaning agent, more effective cleaning can be attained. One embodiment of this cleaning method of the present invention is described
5 below.

First, cleaning for removing wax and particles is performed by using the cleaning agent composition of the present invention comprising a nonionic surfactant of formula (I) $[R^1O(EO)_x(PO)_yH]$, TMAH and an alkanolamine. In
10 this cleaning agent, hydrogen peroxide may be added, if desired.

Then, cleaning for removing particles is performed by using a cleaning agent containing aqueous ammonia and aqueous hydrogen peroxide.

15 Each cleaning step may be performed multiple times or a rinsing step of using, for example, water may also be performed. After the completion of all cleaning steps, the wafer is dried by using an organic solvent such as isopropyl alcohol. On the thus-dried semiconductor wafer,
20 not only wax is removed but also good particle level is attained and at the same time, the wafer surface is less etched as compared with the case of using a conventional cleaning solution.

Those two cleaning steps each is not particularly

limited in the cleaning temperature, cleaning conditions and the like, and proper conditions can be appropriately selected according to the wafer to be cleaned.

For example, the cleaning is specifically performed
5 by a method of subjecting a cleaning agent composition having dipped therein a wafer to be cleaned, to filtration and circulation through an appropriate filter for removal of particles, so that particles in the solution can be removed. In this case, when the cleaning agent
10 composition of the present invention is used, the number of particles in the cleaning agent solution can be always maintained to a low level and in turn the amount of particles re-adsorbed to the wafer surface can be decreased, as a result, cleaning with excellent particle-
15 removing performance can be performed.

<Method for Producing Semiconductor Wafer>

The method for producing a semiconductor wafer of the present invention is described below. In the following, the method for producing a silicone wafer,
20 which is one embodiment of the production method of the present invention, is described, however, the present invention is not limited only to the production method of a silicon wafer but can be also applied, for example, to a wafer of one-element semiconductor such as germanium or

compound semiconductor such as gallium-arsenic, gallium-phosphorus and indium-phosphorus.

The method for producing a semiconductor wafer of the present invention comprises:

- 5 lapping the wafer surface;
- specularly polishing the wafer surface;
- cleaning the wafer using the above-described cleaning agent composition of the present invention; and
- cleaning the wafer using a composition containing
- 10 ammonia and hydrogen peroxide.

As a previous step of these steps, a silicon single crystal is withdrawn and the withdrawn ingot is passed through circumferential grinding and orientation flatting and then sliced into a wafer shape. The produced wafer is

15 passed through a beveling (side polishing) step and a lapping (surface polishing) step, and then transferred to a polishing (specular polishing) step.

The specular polishing of wafer is performed by bonding/fixing the wafer to a glass- or ceramic-made plate

20 (jig) with a wax (adhesive) and polishing the wafer surface with an abrasive and an abrasive cloth. After the completion of specular polishing, the wafer is stripped off from the plate and transferred to the cleaning steps to remove wax or particles adhering to the wafer or remove

contamination such as metal impurities.

This cleaning step is the same as in the above-described cleaning method of the present invention and comprises a cleaning step of using the cleaning agent
5 composition of the present invention and a cleaning step of using a composition containing ammonia and hydrogen peroxide.

After the completion of cleaning, the wafer surface is inspected and a product semiconductor wafer is obtained.

10 According to this production method, a semiconductor wafer extremely reduced in particles adhering to the semiconductor wafer surface and in the surface roughening can be obtained.

For example, a semiconductor wafer where the number
15 of particles adhering to the wafer surface and having a particle size of 0.2 μm or more is 130 or less per 100 cm^2 of the wafer surface can be obtained.

When the particles are counted without limitation of the wafer size, a semiconductor wafer where the number of
20 particles adhering to the wafer surface and having a particle size of 0.2 μm or more is 100 or less per one sheet of wafer (for example, 4-inch size) can be obtained.

In the case where a silicon wafer is used as the wafer, a semiconductor wafer having a surface roughness

(Ra) of 0.2 nm or less is obtained.

In the case where a gallium-arsenic wafer is used as the wafer, a semiconductor wafer having a surface roughness (Ra) of 0.4 nm or less is obtained.

5 Here, Ra is determined by applying a calculation described in JIS B 0601 "1994: Hyomen Arasa - Teigi oyobi Hyoji (Surface Roughness - Definition and Indication)", to the roughness curve obtained by scanning the wafer surface with an atomic force microscope. More specifically, just
10 a standard length is extracted from the roughness curve in the direction of its average line, the average line direction and the longitudinal magnification direction in this extracted portion are taken as X-axis and Y-axis, respectively, and when the roughness curve is represented
15 by $y=f(x)$, Ra is a value obtained according to the following equation and expressed by nanometer:

$$Ra = \frac{1}{l} \int_0^l |f(x)| dx$$

(wherein l represents a standard length).

EXAMPLES

20 The present invention is described in greater detail below by referring to Examples and Comparative Examples, however, the present invention is not limited to these Examples.

[Etching Rate]

Cleaning agent compositions of Examples 1 and 2 and Comparative Examples 1 to 5 were prepared by adding water to the blending components shown in Table 1 to make 100 wt%. Each composition was measured on the etching rate for a silicon wafer.

The measurement was performed by the following method. A P-type (100) single crystal silicon wafer was treated with dilute hydrofluoric acid to remove the natural oxide film and then dipped in each cleaning agent composition for 70 hours. From the change in the weight of wafer between before and after the dipping, the total etching rate on the entire surface (front surface, back surface, side surfaces) of wafer was calculated.

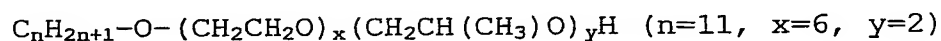
The results obtained are shown in Table 1.

[Table 1]

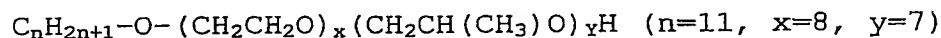
		Example		Comparative Example				
		1	2	1	2	3	4	5
Blending Components (wt%)	TMAH	0.08	0.08	0.08	0.08	0.08	0.08	0.08
	Nonionic Surfactant (1)-1	0.1						
	Nonionic Surfactant (1)-2		0.1					
	Nonionic Surfactant (2)-1			0.1				
	Nonionic Surfactant (2)-2				0.1			
	Nonionic Surfactant (2)-3					0.1		
	Nonionic Surfactant (3)-1						0.1	
	Nonionic Surfactant (4)-1							0.1
Etching rate (Å/min)		3.0	2.6	3.3	4.3	4.8	6.4	3.4

TMAH: Tetramethylammonium hydroxide

Nonionic Surfactant (1)-1:



5 Nonionic Surfactant (1)-2:



Nonionic Surfactant (2)-1:

Polyoxyethylene nonylphenyl ether (ethylene oxide addition molar number: 10)

10 Nonionic Surfactant (2)-2:

Polyoxyethylene nonylphenyl ether (ethylene oxide addition molar number: 15)

Nonionic Surfactant (2)-3:

Polyoxyethylene nonylphenyl ether (ethylene oxide addition molar number: 20)

Nonionic Surfactant (3)-1:

5 Pluronic type (polypropylene glycol molecular weight: 2,250, ethylene oxide content: 40 wt%)

Nonionic Surfactant (4)-1:

Polyoxyethylene alkyl ether (HLB: 14.5)

As apparent from the results in Table 1, the
10 cleaning agent compositions of Examples 1 and 2 where the nonionic surfactant of formula (I) is used in combination with a quaternary ammonium hydroxide show a low etching rate on the silicon wafer and accordingly, the wafer surface is less damaged by the cleaning.

15 On the other hand, in Comparative Examples 1 to 5 where a compound other than the specific structure of formula (I) is used, even if the compound is a polyoxyalkylene-base nonionic surfactant, the etching rate on the silicon wafer is high and therefore, the damage of
20 the wafer surface is large as compared with Examples 1 and 2.

As verified above, by using the nonionic surfactant of formula (I) in combination with a quaternary ammonium hydroxide, the etching rate can be satisfactorily

controlled.

[Removability of Wax Contamination]

A commercially available wax (Alfa-Liquid TR-100, trade name, produced by Intec) was coated to a thickness of 1.7 μm on a 6-inch P-type (100) single crystal silicon wafer surface and then baked at 80°C for 5 minutes to produce a test wafer.

Cleaning agent compositions of Examples 3 and 4 and Comparative Example 6 were prepared by adding water to the blending components shown in Table 2 to make 100 wt% and the test wafer was dipped in each cleaning agent composition at 25°C for 6 minutes. Thereafter, the test wafer was rinsed with ultrapure water for 6 minutes and then dried. A light-gathering lamp was applied on the treated wafer surface and the wax removability was evaluated with a naked eye according to the following criteria.

Criteria:

- : Wax was completely removed.
- △: Wax partially remained.
- ×: Wax remained over the entire surface of wafer.

The evaluation results are shown in Table 2.

[Table 2]

		Example	Example	Comparative Example
		3	4	6
Blending Components (wt%)	TMAH	0.1	0.1	0.1
	Monoethanolamine	0.1	0.1	
	Isopropyl alcohol			0.6
	Nonionic Surfactant (1)-1	0.1	0.1	
	Nonionic Surfactant (4)-2			0.1
	Anionic Surfactant (1)		0.1	
Wax removability :		○	○	△

Nonionic Surfactant (4)-2:

Pluronic type (ADEKA L61) (polypropylene glycol molecular weight: 1,750, ethylene oxide content: 10 wt%)

5 Anionic Surfactant (1): $C_7F_{15}COOH$

As apparent from the results in Table 2, when treated with the cleaning agent compositions of Examples 3 and 4 where the nonionic surfactant of formula (I) is used in combination with a quaternary ammonium hydroxide, the wax on the wafer surface is completely removed at the observation with a naked eye and these compositions have excellent wax removability.

On the other hand, in Comparative Example 6 where a compound other than the specific structure of formula (I) is used, the wax remains on the wafer surface at the observation with a naked eye and the wax removability is

insufficient.

In this way, by using the nonionic surfactant of formula (I) in combination with a quaternary ammonium hydroxide, an excellent result is obtained also in the wax
5 removability.

[Filterability of Particle]

In a polyethylene-made container, 20 L of each cleaning agent composition of Example 5 and Comparative Example 7 was produced by adding water to the blending
10 components shown in Table 3 to make 100 wt%.

Each cleaning agent composition was filtered and circulated at a rate of 2 L/min through a 0.05- μ m Teflon(R) filter to remove particles in the solution. The number of particles was measured at the preparation of
15 solution and after filtration and circulation for 10 minutes. For the measurement of the number of particles, an in-liquid particle counter KL-20 manufactured by Rion Co., Ltd. was used.

The measurement results are shown in Table 3.

[Table 3]

		Example	Comparative Example
		5	7
Blending Components (wt%)	TMAH	2.5	2.5
	Nonionic Surfactant (1)-1	0.5	
	Nonionic Surfactant (2)-1		0.5
Number of Particles (0.2 μ m, /ml)	At the preparation of solution (before filtration/circulation)	4579	2908
	After filtration/circulation for 10 minutes	240	2683

As apparent from the results in Table 3, the cleaning agent composition of Example 5 where the nonionic surfactant of formula (I) is used in combination with a quaternary ammonium hydroxide is remarkably excellent in the filterability of particles as compared with the cleaning agent composition of Comparative Example 7 where a compound other than the specific structure of formula (I) is used.

10 In this way, by using the nonionic surfactant of formula (I) in combination with a quaternary ammonium hydroxide, excellent filterability of particles can be obtained.

Furthermore, when circulation through a filter is performed at the cleaning of wafer, the number of particles in the solution can be always maintained to a very low level, as a result, the amount of particles re-

adsorbed to the wafer surface can be reduced.

[Solubility of Surfactant in Aqueous Alkali Solution]

Cleaning agent compositions of Examples 6 to 8 and Comparative Example 8 each was prepared from the blending components shown in Table 4 and water by adding the surfactant to an aqueous alkali solution prepared by dissolving TMAH in water, to make a total of 100 wt%. At the preparation, whether the solution became turbid on adding the surfactant to the aqueous alkali solution was observed with a naked eye, thereby evaluating the solubility of surfactant. The evaluation was performed according to the following criteria:

Criteria:

○: The solution did not become turbid and remained colorless and transparent.

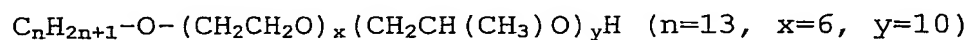
×: The solution became turbid.

The evaluation results are shown in Table 4.

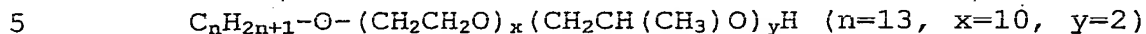
[Table 4]

		x/(x+y)	Example			Comparative Example
			6	7	8	8
Blending Components (wt%)	TMAH	-	0.1	0.1	0.1	0.1
	Nonionic Surfactant (1)-3	0.37				0.1
	Nonionic Surfactant (1)-2	0.53	0.1			
	Nonionic Surfactant (1)-1	0.75		0.1		
	Nonionic Surfactant (1)-4	0.83			0.1	
Solubility			○	○	○	×

Nonionic Surfactant (1)-3:



Nonionic Surfactant (1)-4:



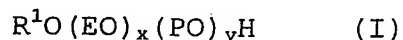
As apparent from the results in Table 4, in Examples 6 to 8 where the nonionic surfactant of formula (I) has an $x/(x+y)$ value of 0.5 or more, the solubility in an aqueous alkali solution is good.

10 On the other hand, in Comparative Example 8 where the $x/(x+y)$ value is less than 0.5, the solubility of surfactant in an aqueous alkali solution decreases. In such a case, another compound such as a water-soluble organic compound (for example, isopropyl alcohol) must be

15 added so as to elevate the solubility of surfactant.

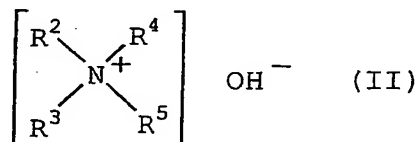
CLAIMS

1 A cleaning agent composition comprising a nonionic surfactant represented by the following formula (I):



5 (wherein R^1 represents a linear or branched alkyl group having from 6 to 20 carbon atoms or a linear or branched alkenyl group having from 6 to 20 carbon atoms, EO represents an oxyethylene group, PO represents an oxypropylene group, EO and PO each is bonded by random
10 addition or block addition, x number of EOs and y number of POs are arranged in an arbitrary order, x and y each independently represents an integer of 1 to 20, and $x/(x+y)$ is 0.5 or more) and a quaternary ammonium hydroxide.

15 2 The cleaning agent composition as claimed in Claim 1, wherein the quaternary ammonium hydroxide is a compound represented by the following formula (II):



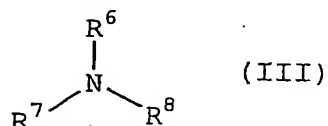
(wherein R^2 , R^3 , R^4 and R^5 each independently represents an
20 alkyl group having from 1 to 6 carbon atoms or a hydroxy-alkyl group having from 1 to 6 carbon atoms).

3 The cleaning agent composition as claimed in Claim 2,

wherein the quaternary ammonium hydroxide is tetramethylammonium hydroxide.

4 The cleaning agent composition as claimed in any one of Claims 1, which further comprises an alkanolamine.

5 5 The cleaning agent composition as claimed in Claim 4, wherein the alkanolamine is a compound represented by the following formula (III):



(wherein R⁶ represents a hydroxyalkyl group having from 1 to 4 carbon atoms; and R⁷ and R⁸ each independently represents a hydrogen atom, an alkyl group having from 1 to 4 carbon atoms, a hydroxyalkyl group having from 1 to 4 carbon atoms or an aminoalkyl group having from 1 to 4 carbon atoms, or R⁷ and R⁸ combine to form an alkylene group having from 3 to 6 carbon atoms, and the alkylene group may have an oxygen or nitrogen atom inserted between carbon atoms constituting the main chain).

6 The cleaning agent composition as claimed in Claim 5, wherein the alkanolamine is any one compound selected from the group consisting of monoethanolamine, diethanolamine and triethanolamine.

7 The cleaning agent composition as Claimed in Claim 4, wherein the alkanolamine is contained in an amount of

0.001 to 50 mass% based on the entire amount of the cleaning agent composition.

8 The cleaning agent composition as Claimed in Claim 1, wherein the nonionic surfactant is contained in an amount
5 of 0.0001 to 10 mass% based on the entire amount of the cleaning agent composition.

9 The cleaning agent composition as Claimed in Claim 8, wherein the quaternary ammonium hydroxide is contained in an amount of 0.001 to 30 mass% based on the entire amount
10 of the cleaning agent composition.

10 A method for cleaning a semiconductor wafer, comprising the steps of:

- (i) cleaning the wafer using the cleaning agent composition as claimed in any one of Claims 1 to 9; and
- 15 (ii) cleaning the wafer using a composition containing ammonia and hydrogen peroxide.

11 The method for cleaning a semiconductor wafer as claimed in Claim 10, wherein the degreasing and removal of particles on the semiconductor wafer surface are performed
20 in the step (i).

12 The method for cleaning a semiconductor wafer as Claimed in Claim 11, wherein the removal of particles on the semiconductor wafer surface are performed in the step (ii).

13 A method for producing a semiconductor wafer, comprising the steps of:

lapping the wafer surface;

specularly polishing the wafer surface;

5 cleaning the wafer using the cleaning agent composition as claimed in any one of Claims 1 to 9; and

cleaning the wafer using a composition containing ammonia and hydrogen peroxide.

14 A semiconductor wafer produced by the production
10 method as claimed in Claim 13.

15 The semiconductor wafer as claimed in 14 wherein the number of particles attached to the wafer surface and having a particle size of 0.2 μm or more is 130 or less per 100 cm^2 of the wafer surface.

15 16 The semiconductor wafer as claimed in Claim 14, wherein the semiconductor wafer is a silicon wafer, a gallium-arsenic wafer, a gallium-phosphorus wafer or an indium-phosphorus wafer.

17 The semiconductor wafer as claimed in Claim 16,
20 wherein the semiconductor wafer is a silicon wafer and the surface roughness (Ra) is 0.2 nm or less.

18 The semiconductor wafer as claimed in Claim 16, wherein the semiconductor wafer is gallium-arsenic wafer and the surface roughness (Ra) is 0.4 nm or less.

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 C11D11/00

C11D1/722

C11D3/30

H01L21/302

H01L21/306

International Application No
PCT/JP 03/15792

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 C11D H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category * Citation of document, with indication, where appropriate, of the relevant passages

Relevant to claim No.

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25 May 2000 (2000-05-25)
page 2, line 62 - page 3, line 21; claims

1-3

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27 September 2001 (2001-09-27)
column 4, paragraph 0023-0025; claims;
examples

1-18

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7 February 2002 (2002-02-07)
claims; examples

1-18

US 2002/022582 A1 (TAKASHIMA MASAYUKI)
21 February 2002 (2002-02-21)
claim 1; examples

1-18

Other documents are listed in the continuation of box C.

Categories of cited documents:
defining the general state of the art which is not
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☒ Patent family members are listed in annex.

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X document of particular relevance; the claimed invention
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Y document of particular relevance; the claimed invention
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document is combined with one or more other such docu-
ments, such combination being obvious to a person skilled
in the art.

Z document member of the same patent family

published prior to the international filing date but
priority date claimed

Completion of the international search

Date of mailing of the international search report

09/03/2004

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2280 HV Rijswijk
31-70) 340-2040, Tx. 31 651 epo nl,
31-70) 340-3016

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/JP-03/15792

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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			US 2002155964 A1	24-10-2002
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			JP 2001288496 A	16-10-2001

1530051

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雨宮 正博 様

[同封書類]

- ・特許明細書
- ・出願書類
- ・譲渡書
- ・産別状



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OR DESIGN PATENT APPLICATION (37 C.F.R. 1.63)****実用・意匠特許出願宣言書および委任状 (37 C.F.R. 1.63)****Japanese Language Declaration**

私は以下の通り宣言します：

各発明者の住所、郵送先、および国籍は下記氏名の後に記載された通りです。

下記名称の発明に関し請求範囲に記載され特許出願がされている発明内容につき、下記に記載された発明者が本来かつ最初の発明者であると信じます。

☐ 上記発明の明細書は本書に添付されます。

または

☐ 上記発明は米国出願番号あるいは PCT 国際出願番号
_____ (確認番号 _____) として _____
年__月__日に提出され、
_____年__月__日に補正されました (該当する場合)。

私は補正が上に明示された場合は補正された特許請求範囲を含む前記明細書の内容を検討し、理解していることをここに表明します。

私は一部継続出願の場合先行出願の出願日から一部継続出願の国内あるいは PCT 国際出願日までの期間中に入手された重要な情報を含み、37 C.F.R. 1.56 に定義される特許性に肝要な情報について開示義務があることを認めます。

I hereby declare that:

Each inventor's residence, mailing address, and citizenship are as stated below next to their name.

I believe the inventor(s) named below to be the original and first inventor(s) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

CLEANING AGENT COMPOSITION, CLEANING
AND PRODUCTION METHODS FOR
SEMICONDUCTOR WAFER, AND
SEMICONDUCTOR WAFER

☐ the specification of which is attached hereto

OR

☒ was filed on December 10, 2003
as United States Application Number or PCT
International Application Number PCT/JP03/15792
(Confirmation No. _____),
and was amended on _____
(if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. 1.56, including for continuation-in-part application(s), material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

Japanese Language Declaration

私は 35 U.S.C. 119(a)-(d) あるいは (f), または 365 (b) に基づき特許、発明者、あるいは植物育種家証書の下記外国出願、または 365 (a) に基づきアメリカ合衆国以外の少なくとも 1 ヶ国を指定した下記 PCT 国際出願についての外国優先権特典をここに主張するとともに、下記項目に x 印を付けることにより優先権を主張する出願以前の出願日を有する特許、発明者、あるいは植物育種家証書の外国出願または PCT 国際出願を示します。

Prior Foreign Application Number(s)
先行外国出願番号

2002-361149
(Application Number)
(出願番号)

Japan
(Country)
(国名)

12 December 2002
(Filing Date)
(出願日)

Priority Claimed?
優先権の主張 ?

Yes No
有り無し

☒ ☐

(Application Number)
(出願番号)

(Country)
(国名)

(Filing Date)
(出願日)

☐ ☐

私は 35 U.S.C. 119(e) に基づき下記の米国仮特許出願の国内優先権をここに主張します。

60/434,663
(Application Number)
(出願番号)

20 December 2002
(Filing Date)
(出願日)

(Application Number)
(出願番号)

(Filing Date)
(出願日)

I hereby claim domestic priority under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

私は 35 U.S.C. 120 に基づき下記米国特許出願、あるいは 365 (c) に基づき米国を指定する下記 PCT 国際出願の利益をここに主張し、本特許出願内特許請求範囲の各項目の内容が 35 U.S.C. 112 の最初の項に規定される方法により先行米国あるいは PCT 国際特許出願で開示されていない限りにおいて 37 C.F.R. 1.56 に定義される本出願の特許性に肝要で、先行特許出願の出願日から本特許出願の国内あるいは PCT 国際出願日までの期間中に入手された情報について開示義務があることを認めます。

Prior U.S. or International Application Number(s)
先行米国あるいは国際出願番号

(Application Number)
(出願番号)

(Filing Date)
(出願日)

(Status: patented, pending, abandoned)
(状態: 特許成立済、係属中、放棄済)

(Application Number)
(出願番号)

(Filing Date)
(出願日)

(Status: patented, pending, abandoned)
(状態: 特許成立済、係属中、放棄済)

私は本宣言書内で私自身の知識に基づいてなされたすべての陳述が真実であり、情報および信ずるところに基づいてなされたすべての陳述が真実であると信じられていることをここに宣言し、さらに故意になされた虚偽の陳述等々は 18 U.S.C. 1001 に基づき罰金あるいは拘禁または両方による処罰にあたり、またかような故意による虚偽の陳述はそれに基づく特許出願あるいは成立特許の有効性を危うくする可能性があることを認識した上でこれらの陳述をなしたことを宣言します。

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Japanese Language Declaration

委任状：私は下記の米国特許商標局（USPTO）顧客番号のもとに記載される SUGHRUE MION 法律事務所のすべての弁護士を、同顧客番号のもとに記載される個々の弁護士は Sughrue Mion 法律事務所のための自由裁量に基づき変更され得ることを認識した上で、本特許出願の手続きおよびそれに関わる米国特許商標局との業務を遂行する弁護士として指名し、本特許出願に関するすべての通信が同 USPTO 顧客番号のもとに提出された住所宛に送付されることを要請します。

POWER OF ATTORNEY: I hereby appoint all attorneys of SUGHRUE MION, PLLC who are listed under the USPTO Customer Number shown below as my attorneys to prosecute this application and to transact all business in the United States Patent and Trademark Office connected therewith, recognizing that the specific attorneys listed under that Customer Number may be changed from time to time at the sole discretion of Sughrue Mion, PLLC, and request that all correspondence about the application be addressed to the address filed under the same USPTO Customer Number.

STATEMENT OF ACCURATE TRANSLATION IN ACCORDANCE WITH 37 C.F.R. §1.69(b):

The declaration and power of attorney is an accurate translation of the corresponding English language declaration and power of attorney.

Signature

Date

WASHINGTON OFFICE

23373

CUSTOMER NUMBER

電話連絡は下記へ：

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(202) 293-7060

Direct Telephone Calls to:

SUGHRUE MION, PLLC
(202) 293-7060

。 かつこ内に署名する

NAME OF SOLE OR FIRST INVENTOR:

唯一あるいは第一の発明者名

Given Name (first and middle [if any])

名 (名およびミドルネーム[該当する場合]) Masahiro

Family Name or Surname

姓 AMEMIYA

Inventor's signature

発明者の署名

Date

日付

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Citizenship

国籍 Japanese

Mailing Address:

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第二の発明者名:

Given Name (first and middle [if any])

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Family Name or Surname

姓 TANAKA

Inventor's signature

発明者の署名

Date

日付

Residence:

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Citizenship

国籍 Japanese

Mailing Address:

郵送先: c/o SHOWA DENKO K.K., 111, Aza Nagayachi, Oaza, Higashinagahara, Kawahigashi-machi, Kawanuma-gun, Fukushima 969-3431 Japan

書留・配達記録郵便物受領証(お客様控)

DOCUMENT 4

(差出人の住所氏名) 山口県周南市関成町4980番地 昭和通工株式会社 徳山事業所 様				
受取人の氏名	引受番号	郵便料	申出損害要償額	摘要
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